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ABSTRACT

Indoor air quality is a major concern for educators involved in the development of new school facilities, or the remodeling and maintenance of existing ones. This guide addresses the issue of air quality, the health concerns involved, and procedures for minimizing the impact of pollutants in the school environment. It defines common indoor air contaminants that are considered harmful and the steps for removing them, including tips on housekeeping, ventilation, and air filtration and purification systems. Concluding comments address specific school design considerations that can significantly affect indoor air quality. (GR)

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INDOOR AIR QUALITY

A GUIDE FOR EDUCATORS

Prepared under the direction of the

SCHOOL FACILITIES PLANNING DIVISION
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PREFACE

This document is a brief description of school facility management concerns about indoor air quality. It is a simplified discussion of problems that can affect the health of both staff and students and includes a list of management procedures that can be used to help mitigate problems of unclean air.

No district can fulfill its educational responsibilities without providing a safe environment for work and learning. But, as the public becomes more aware of the dangers of pollutants, more people will begin to ask questions about the safety of that environment. This guide, plus additional reading, may help answer these questions and deter problems.

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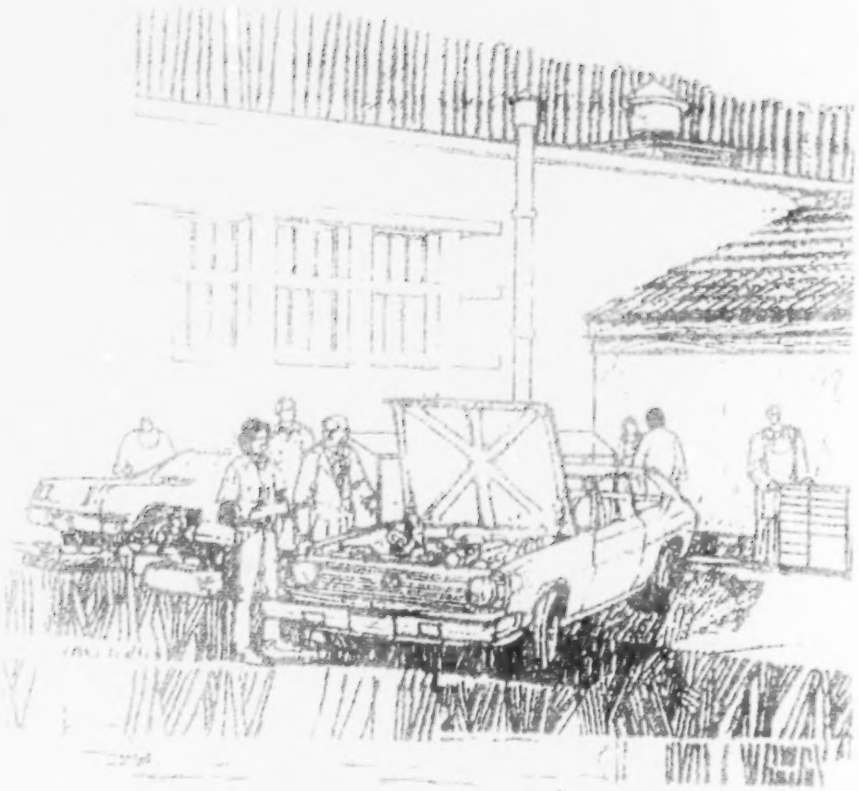
INTRODUCTION

Indoor air quality is a major concern for educators involved in the development of new school facilities and in remodeling or maintenance of existing ones.

The purpose of this guide is to raise an often misunderstood health issue and to suggest procedures that may minimize the impact of pollutants in the school environment. This document is advisory in nature and is not binding on local districts.

No one, at present, has a complete understanding of the health risks associated with low-level exposure to pollutants, both individually and in combination. Therefore, it is prudent to eliminate, or at least mitigate, sources of potentially harmful substances.



HARMFUL SUBSTANCES

Common indoor air contaminants include the following:

A. **Volatile organic compounds** (VOC), such as formaldehyde and toluene (emitted by building and furniture materials, cleaning solvents, pesticides and tobacco smoke)

B. **Microorganisms**, such as bacteria, viruses, molds and fungi (associated with improperly maintained heating, ventilating, and air-conditioning systems or wetted building materials)

C. **Combustion products**, such as carbon monoxide and particulates (generated by both inside and outside sources of combustion)

D. **Ozone and odors** (from outside sources)

E. **Radon** (from the natural decay of uranium in soil)

F. **Asbestos** (occurring in common building materials in older structures not previously surveyed and abated per the federal Asbestos Hazard Emergency Response Act, AHERA)

G. **Lead** (occurring in common materials in older facilities, especially paint, solders, water, and soil)

H. **Insect, animal, and bird infestations** (contributing waste products, bacteria, and allergens)

In addition to affecting the health of occupants and causing potential legal problems, contaminants damage building components and contents, thereby increasing operation, maintenance, and replacement costs.

MANAGEMENT PROCEDURES

Indoor air quality problems can be managed using one or more of the following procedures:

A. Remove pollution sources.

1. Clean or replace contaminated heating, ventilating, and air-conditioning system components, including ducts and filters.
2. Remove water-damaged ceiling tiles, carpet, and other building materials.
3. Prohibit or severely curtail smoking.
4. Use and store paints, adhesives, solvents, and pesticides in well-ventilated areas. Purchase these items in small quantities to avoid storage exposure.
5. Consider air quality in the selection of materials.
   a. Avoid any product with a strong odor.
   b. Specify woven carpet without liquid latex or vinyl backing materials. Do not install with glue.
   c. Specify linoleum with a linseed oil base, not sheet vinyl.
   d. Avoid topical biocidal solutions.
   e. Seal fibrous insulation from the air supply.
   f. Avoid products containing urea-formaldehyde.
   g. Specify mercury and lead free, nontoxic paints.
6. Seal slabs and exterior walls against radon.
7. Encapsulate or remove asbestos (per AHERA).
8. Remove existing lead paint (use safe procedures).
9. Test soil for lead and, if necessary, limit exposure using walk-off mats at doors and covering soil with planting or paving.
10. Control pest infestations through good housekeeping and repair. Limit the use of pesticides.

B. Review housekeeping and maintenance procedures.

1. Schedule the use of polluting products early on weekends or vacation periods to allow fumes to dissipate before the building is reoccupied. Use fans during application.
2. Use low-emission cleaning products when available.
3. Avoid aerosols, including air-fresheners.
4. Use plain water or soap and water as cleaning agents.
5. Remove dust with vacuum cleaners and/or damp cloths. Do not use feather dusters or spray dust collectors.
6. Avoid moisture problems with prompt cleanup of spills and additional ventilation.
7. Minimize the use of herbicides and pesticides on landscaping.

C. Increase ventilation.

1. Provide windows that open and close.
2. Design ventilation systems capable of purging the building quickly with 100 percent fresh or purified air.
3. Change filters frequently.
4. Provide separate ventilation to outdoors at copiers and computers.

D. Provide air filtration or purification systems.

E. Educate people.

1. Train maintenance staff to operate and maintain heating, ventilating, and air-conditioning systems as necessary to effect optimum performance.
2. Train staff in the safe and appropriate uses of pesticides and cleaners.
3. Keep students, parents, and staff aware of efforts to deal with problems.
4. Direct building committees to insist that air quality be considered in the design of new or remodeled facilities.

DESIGN CONSIDERATIONS

Well-designed buildings are energy efficient, minimize environmental concerns, enhance occupants' health and comfort, promote cost savings, and reduce potential liability.

The following mitigation procedures can be considered during the design process to significantly affect indoor air quality.

A. Site Planning and Selection

1. Avoid locating facilities near sources of combustion products (such as freeways or power plants), dust generators (such as agricultural activities), and industrial plants that may emit pollutants or odors into the air. Refer to the California Department of Education's *School Site Selection and Approval Guide* and *School Site Analysis and Development*.
2. Check with local environmental health authorities about the presence of radon or other potentially harmful substances.
3. Separate vehicle access, loading docks, and pedestrian drop-off points from air intakes and building entries.
4. Consider prevailing winds in locating buildings, entrances, windows, air intakes, and vehicle areas.

B. Architectural Design

1. Problems with indoor air quality can result in part from poor decisions during the design phase. A building's shape and size, orientation, layout, proximity to pollutant-generating activities, building materials, types of windows and doors, and ventilation system design can all affect indoor air quality. It is more cost effective to consider these items early in the project and to include them in the contract documents rather than to deal with the resulting problems after construction and after the building is occupied.
2. Building areas such as housekeeping storage, toilets, workshops, cooking areas, art and hobby rooms, and other emission-producing spaces can be sources of pollution. They should be located where emissions can be isolated and controlled.
3. Windows that open and close allow natural ventilation. The use of such windows conflicts with energy conservation procedures, but air quality concerns may supersede conservation demands. All options should be considered.

C. Selection and Specification of Materials

1. Use building materials known to have low pollutant-emission characteristics. When these materials are not available, contamination of air in the facility should be controlled by temporary ventilation, off-site curing, and/or isolation of such materials from the interior environment.

2. Require complete emissions data from manufacturers before specifying or approving products.

3. Consider maintenance requirements. Cleaning solvents are an important source of volatile organic compounds. Select materials that can be cleaned with soap and water.

4. Consider the projected life cycles of materials. Materials that wear out quickly require more frequent replacement, with additional emissions at each replacement cycle.

5. Document design assumptions thoroughly and provide clear, detailed descriptions of building systems in the construction contract documents.

6. Specify temporary additional ventilation to be provided immediately before and during initial occupancy of new and renovated buildings.

   a. Continuous ventilation with outside air minimizes occupant exposure to emissions from new materials and furnishings. This period of superventilation should last from three to eight weeks—the longer the better.

   b. Purging-type ventilation procedures should be used for at least one to two hours to flush the building of accumulated contaminants after a period of vacancy, e.g., weekends, evenings, and holidays.

7. Specify "bakeout" procedures prior to occupancy. Bakeout involves raising building temperatures for 48 hours or more while maintaining ample ventilation. It results in more rapid emissions of volatile organic compounds prior to occupancy and may reduce occupant exposure to contaminants. Bakeout is not a trivial procedure in terms of technical requirements and costs. If bakeout is specified, include high-register thermostat controls to accommodate the procedure. Bakeout is also controversial in that it may release pollutants that otherwise would never have entered the environment.

8. Require pretreatment of materials where possible to eliminate pollutants. The type of pretreatment would depend on the type of material. For instance, vinyl-impregnated flooring might be subjected to a factory bakeout, and furniture or carpet might be unwrapped in a superventilated warehouse and remain there until airborne pollutants are dissipated.

9. During construction, renovation, or relocation, protect building occupants from fumes and dust.

   a. Isolate the occupied area from construction.

   b. Identify and control sources of contamination.

   c. Provide superefficient filters in the existing air-conditioning system.

   d. Provide temporary ventilation.

   e. Reduce exposure to contaminants by carefully scheduling both construction and occupant activities.

   f. Consider temporary relocation of occupants.

   g. Study asbestos abatement projects for applicable types of barriers, temporary ventilation equipment, and management strategies that can control temporary sources of contamination.

D. Design of the Ventilation System

1. Ample ventilation is essential. It is impossible to avoid all contaminant sources through design. Contaminants are too numerous, too diverse, and often outside the control of the designer. Dilution with clean air should be planned.

2. Significant increases in ventilation do not result in corresponding increases in operating and initial construction costs. A significant increase in ventilation, as recommended by ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers) will increase the costs of fuel, maintenance, and original equipment by very little. Instruct your architect to refer to ASHRAE 62-1989.

3. Locate air intakes to avoid contaminants from vehicle and building exhausts, neighboring activities, and sources of moisture. Maintain building air pressure so that air movement, if any, is toward the outdoors.

4. Where outdoor air is contaminated, specify air cleaning and filtration as appropriate.

5. Air distribution design is critical. Be certain that system designers consider and attempt to mitigate the problems of indoor air quality.

CONCLUSION

Design professionals sometimes give inadequate consideration to indoor air quality. Building codes do not adequately cover air quality requirements. Therefore, building owners must insist that designers protect them from problems and liability arising from contaminated environments.

The points of view of occupants, building owners or managers, designers, product manufacturers, builders, codes and standards organizations, lenders, and insurers are diverse and sometimes conflict. Controlling energy consumption, indoor air quality, and other environmental factors involves coordinating these points of view and resolving differences.

The goal of safe and healthful air is achievable through attention to building design and operation. Concern for detail can result in buildings that promote learning and protect the health of our most valuable resource, California's schoolchildren.

RECOMMENDED READING

Building Air Quality. A Guide for Building Owners and Facility Managers, EPA/400/-91/623. Washington: Environmental Protection Agency, 1991. (#15BNO-16-035919-8, Superintendent of Documents, Mail Stop SSOP, Washington, DC 20402-9328).

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Ventilation for Acceptable Indoor Air Quality, Standard 62-1989. Atlanta: ASHRAE, 1989. (404-636-8400).

INFORMATION SOURCES

The following organizations may be contacted for additional information:

School Facilities Planning Division, California Department of Education
(916) 322-2470

Research Division, California Air Resources Board
(916) 323-1504

Division of Occupational Safety and Health, California Department of Industrial Relations
(916) 920-6123

Environmental Health Investigations Branch, California Department of Health Services
(916) 445-4171

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